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MEASURING AND STANDARDIZING HANDWRITING IN A SCHOOL SYSTEM

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INTRODUCTION

There are two handwriting scales in common use, the Thorndike scale and that of Ayres. Both have been of inestimable value to the elementary school. By means of them, teachers have been able to rate the handwriting of pupils by a more scientific method. However, while these scales constitute a means of measurement, they do not establish a standard of measure for the writing work of the several grades. Hence arises the need of standard scores or the establishment of norms. In the opinion of the writers it is highly desirable for any considerable school system, with the use of approved methods and the instruments of measurement now available, to do three things for itself: (1) measure its present achievement, (2) establish norms of achievement, and (3) construct its own scales for measuring achievement. These three ends are easily accomplished as parts of one continuous investigation. In advising the construction of local scales, it is not intended to encourage a plan that will isolate the school system; that is, discourage comparative measurement through a variety of scales. These scales should be so constructed that their values are directly convertible into the values of some satisfactory general scale, such as we hope the Thorndike scale will in time be made.

Following is the report of an attempt to carry out the program above for the city of Highland Park, Michigan, in Grades 3–6, inclusive. This report covers the method of testing, scoring of papers, tabulating data, determining norms, and selecting the specimens of handwriting for five grade-section scales.

Highland Park has five six-grade elementary schools. For various reasons it was not deemed advisable to carry this work below the third grade or beyond the sixth grade into the junior high school. This system of schools has semiannual promotions, hence the division of each grade into B and A sections, B indicating the first half and A the last half of the year's work. In this investigation each half-year was studied separately. The number of specimens of handwriting from each grade was as follows: 3B, 181; 3A, 169; 4B, 166; 4A, 181; 5B, 190; 5A, 150; 6B, 138; 6A, 92; making a total of 1,267 samples.

METHOD OF TESTING

The handwriting test was given at the end of a semester's work. Uniformity in administering the test was strictly adhered to. Children in the same grade in the same and different schools received the test at the same time of day. It seemed best, since both quality and speed were to be considered, to have the test administered by the two principals who were interested in working out the problem.[1] It was feared that if the test were conducted by the teachers some teachers might stress quality at the sacrifice of speed, others speed at the sacrifice of quality. And, with two principals conducting the test, arrangement was made so that personal connection with a particular school was not given an opportunity to affect the test.

In order that there might be uniformity of materials, uniform paper was used and the same pens were taken from grade to grade. A stop-watch was employed to increase the probability of an accurate and uniform time allowance.

The copy was so simple that the children did not have to spend time memorizing it, much less lose time dividing attention between their writing and the copy. To guard against hesitation over the spelling of a word, the copy was written on the blackboard a few minutes before the signal was given to begin writing. The copy was "Mary had a little lamb." It has its limitations in that it contains but eleven letters of the alphabet. This, however, is more than compensated for by its familiarity.

The instruction given to each grade was in content as follows: We wish to get a sample of your handwriting. You will be marked on both how well you write and how fast you write, so we want you to write just as well as you can and just as fast as you can. You will be given just two minutes to write as many times as you can what has been written on the board, "Mary had a little lamb." Write it once on each line. Start when the signal is given to start, and when the signal is given to stop let each one hold up his pen.

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[1] The writers are indebted to Principal E. H. E. Mumford for valuable assistance in administering the test and in tabulating data.

SCORING THE PAPERS

In order that there might be no identifying marks on the papers to prejudice any judge, provision was made for detachable headings. The pupils were requested to write their names and the date on the first line of the paper; on the second line the name of the school, their sex, and their age. Two lines below this they were asked to place a check mark, at which point they were told to begin writing when the signal was given. With an automatic numbering machine a number was stamped on the heading, and the same number on the body of the paper. The headings were then removed. The numbers used were significant in identifying the grade of a paper. The papers of Grade 3B began with 3,001, those of 3A with 3,501, and so on.

Five judges scored each sample. Two of them were the principals who gave the tests, one, a young woman, not a teacher, who was in the employ of the city board of education to do scoring work, and two, young ladies, students of education at the University of Michigan. Each scorer was provided with a sheet ruled in columns and numbered according to the numbers of the samples. The Thorndike scale was used for the scoring. After the scoring was completed, the scores for each sample were averaged and this average was considered the final score of the sample. Finding the speed in number of letters a minute was a simple matter. The letters on each sample were counted and the total divided by two.

DETERMINING STANDARDS IN QUALITY

When the scores for the samples of a single grade had been arranged in order of quality, it was found that there was a close approximation to a normal distribution. Table I shows the distribution for all grades. This table also exhibits clearly the amount of overlapping that exists among the grades.

Two methods presented themselves for the selection of samples to be used in the scale. The first, and the one finally adopted, was to locate the median, then measure equal steps in Thorndike-scale units either way from the median. The other method was to locate

TABLE I

DISTRIBUTION OF QUALITIES FOR ALL GRADES

QUALITY ON THE THORNDIKE SCALE	NUMBER OF SAMPLES OF EACH QUALITY IN EACH GRADE							
	3B	3A	4B	4A	5B	5A	6B	6A
5.8	1	1	......	......	......	1	......	......
6.0	3	2	......	......	......	1	......	......
6.2	4	2	3	......	......	1	......	......
6.4	6	......	......	1	1	......	......	......
6.6	8	3	2	2	......	......	......	......
6.8	7	6	2	2	1	1	......	......
7.0	7	6	3	5	......	1	......	......
7.2	11	5	4	7	1	1	1	......
7.4	14	9	8	10	2	2	1	......
7.6	20	17	11	10	2	7	2	3
7.8	9	17	6	11	9	6	4	......
8.0	18	16	12	13	6	8	1	3
8.2	20	22	21	14	10	6	6	5
8.4	10	12	11	10	9	7	6	3
8.6	13	17	13	10	12	6	8	3
8.8	13	11	14	9	18	9	7	4
9.0	5	3	18	13	12	9	8	2
9.2	3	8	10	9	16	8	11	3
9.4	2	3	8	11	12	9	5	9
9.6	1	4	7	11	11	14	10	6
9.8	1	2	3	3	10	8	7	12
10.0	......	2	2	5	12	7	7	6
10.2	2	......	3	9	6	5	12	4
10.4	2	......	2	1	6	6	6	3
10.6	......	1	3	3	10	9	4	3
10.8	1	......	......	3	7	6	5	2
11.0	......	......	......	3	4	1	7	7
11.2	......	......	......	4	7	2	4	3
11.4	......	......	......	1	1	4	3	3
11.6	......	......	......	1	1	1	3	1
11.8	......	......	......	......	1	2	2	2
12.0	......	......	......	......	1	1	4	1
12.2	......	......	......	......	......	1	1	......
12.4	......	......	......	......	......	......	1	......
12.6	......	......	......	......	......	......	......	2
12.8	......	......	......	......	......	......	......	1
13.0	......	......	......	......	1	......	......	......
13.2	......	......	......	......	......	......	1	1
13.4	......	......	......	......	......	......	......	......
13.6	......	......	......	......	......	......	......	......
14.8	......	......	......	......	......	......	1	......
15.0	......	......	......	......	1	......	......	......

the median, assume a normal distribution, and calculate equal sigma[1] distances either way from the median.

In both cases it was discovered that five qualities would satisfactorily represent the range of variation in the grades studied. Table II shows these five qualities for each section of each grade when a normal distribution was assumed and sigma distance used as the length of step. Table III shows the five qualities when the unit of measurement was a Thorndike-scale step.

TABLE II

QUALITIES AT SIGMA DISTANCES FROM GRADE MEDIANS, SAMPLES ARRANGED IN ORDER OF QUALITY

Distance in Sigma Units	Qualities in Each Grade by the Thorndike Scale							
	3B	3A	4B	4A	5B	5A	6B	6A
−2	6.2	6.2	6.6	6.8	7.6	6.8	7.6	7.6
−1	6.8	7.4	7.6	7.6	8.2	8.0	8.6	8.6
Median	8.0	8.2	8.6	8.6	9.2	9.4	9.6	9.8
+1	8.6	8.8	9.4	9.6	10.6	10.6	11.0	11.0
+2	10.2	9.8	10.4	11.2	11.4	11.8	12.2	12.8

TABLE III

QUALITIES AT THORNDIKE-UNIT DISTANCES FROM GRADE MEDIANS, SAMPLES ARRANGED IN ORDER OF QUALITY

Distance in Thorndike Units	Qualities in Each Grade by the Thorndike Scale							
	3B	3A	4B	4A	5B	5A	6B	6A
−2	6.0	6.2	6.6	6.6	7.2	7.4	7.6	7.8
−1	7.0	7.2	7.6	7.6	8.2	8.4	8.6	8.8
Median	8.0	8.2	8.6	8.6	9.2	9.4	9.6	9.8
+1	9.0	9.2	9.6	9.6	10.2	10.4	10.6	10.8
+2	10.0	10.2	10.6	10.6	11.2	11.4	11.6	11.8

A comparison of the data in Table II and Table III shows that the two methods yielded very similar results. Five steps by either method covered practically the same range. Since, however, a scale is more satisfactory if it comprises a series of samples differing from each other consecutively by *equal steps*, it is evident that the values of Table III are preferable to those of Table II. Table II is interesting, nevertheless, because of the check it furnishes, or the light it throws, on a well-known method of selecting samples for an educational scale. This method proceeds by (1) arranging the samples according to the amount of the merit to be measured, (2) locating the median sample, and (3) using the values of the normal probability integral corresponding to the values of sigma or the probable error in locating in either direction from the median other samples differing from each other consecutively by equal amounts of the merit in question. Theoretically, the length of the steps in any one scale in Table II should approximate equality. With an increasing number of samples there should be a closer approximation to equality. The closeness of the approximation for the comparatively small number of samples for each grade, in no case more than 189, should be interesting to students of measurement.

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[1] For table of values, see Thorndike's *Mental and Social Measurements*, 1913, p. 198.

As may be seen by referring to Table I, there were in most cases several samples at each of the foregoing scale steps. For instance, in Grade 3B 18 samples were located at quality 8.0. When it became necessary to choose one of these samples for use in the scale, it seemed best, first to reject a few samples that were undesirable on account of degree of slant, size of letters, or untidy or misspelled copy, and then to select the scale sample by a random choice from the rest. This was accordingly done.

While from some points of view it might appear more scientific to derive the scale samples by a random selection from all the samples, yet on the whole the foregoing procedure was probably best for the purposes of this investigation. Schools in the teaching of handwriting rightly adopt from scientific studies and expert opinion certain definite aims as to slant, size, style, and the like, of letters. For example, a combination of scientific evidence and expert opinion at the present time favors writing of medium slant. If one locate medium slant between 55 and 80 degrees, he is justified in rejecting samples of equal general merit beyond these limits in either direction. We are setting standards as well as measuring achievement. Likewise in the matter of size, style, and other characteristics.

DETERMINING STANDARDS IN SPEED

Thus far only quality has been considered. But standardization of handwriting cannot stop with the establishment of quality norms. It is well known that quality can be secured by a teacher at the expense of speed, or vice versa. The process of standardization will not be satisfactory until a quality for a given grade is established which is to be produced by that grade at an established rate. This rate should not be left to mere opinion, even that of an expert. It should be based on the actual possibilities of achievement in the grade for which it is intended. What are these possibilities, as indicated by actualities? The problem really resolves itself into that of the relation between speed and quality in handwriting.

An examination of speed values revealed a wide variation in the rapidity of writing in all grades. In Grade 3B, for instance, the range of variation was from 10 to 81 letters a minute. The results of a study of distribution of speeds in the various grades did not seem important enough to recount in detail. Incidentally it might be remarked that at first glance there appeared to be no tendency toward a normal distribution. When, however, the samples were arranged in the order of speed and collected into groups marked off at ten-point intervals in speed, the expected normal distribution was evident.

TABLE IV

AVERAGE SPEED OF QUALITY GROUPS AT SIGMA POINTS, SAMPLES ARRANGED IN ORDER OF QUALITY

SIGMA POINT	SPEED IN LETTERS A MINUTE IN EACH GRADE							
	3B	3A	4B	4A	5B	5A	6B	6A
−2	37.6	46.0	44.0	42.7	59.7	70.5	63.0	77.7
−1	32.2	51.8	49.5	62.4	57.9	70.3	77.7	87.1
Median	36.0	45.5	50.5	60.1	60.0	65.4	70.4	71.2
+1	42.4	53.1	48.4	60.9	57.1	65.0	76.1	71.5
+2	35.5	38.0	42.2	70.2	38.0	51.0	67.0	81.0

Quality and speed within grades.—A study of the speed-quality relation was begun by determining the average speed at which each quality group of samples shown in Table II was written. The average speed of these quality groups is presented in Table IV.

The groups here, let the reader be reminded, are five in number in each grade, a group being composed of those samples that fall exactly *at* one of the five points named in the table—the median, one and two units below the median, and one and two units above the median, sigma being the unit. It is not clear from Table IV that within the grades speed showed any regular decrease or increase as quality improved. Neither positive nor negative correlation was manifest. Since, however, only a part of the samples were included in these sigma-point groups, it seemed best to approach the problem from a slightly different angle. In Table V all the samples were considered, the preceding sigma points being merely the centers of the groups.

TABLE V

AVERAGE SPEED OF QUALITY GROUPS WITHIN SIGMA INTERVALS, SAMPLES ARRANGED IN ORDER OF QUALITY

SIGMA INTERVAL	SPEED IN LETTERS A MINUTE IN EACH GRADE								
	3B	3A	4B	4A	5B	5A	6B	6A	Average
−2.5 to −1.5..	39.2	45.7	34.6	55.1	66.6	57.8	65.0	85.2	56.2
−1.5 to − .5..	36.2	46.7	52.7	60.4	58.6	66.7	70.7	79.9	59.0
− .5 to + .5..	34.5	46.5	52.8	60.7	58.7	64.4	68.5	69.9	57.0
+ .5 to +1.5..	38.6	51.4	54.2	58.4	60.8	59.2	71.4	71.2	58.2
+1.5 to +2.5..	36.4	40.6	40.7	57.3	55.8	55.4	65.9	62.4	51.8

The values of Table V suggest an inverse relationship between quality and speed within the grades. In the general averages, final column, this general tendency is apparent. When the averages for Grades 5 and 6 are computed, we find the following average speeds as quality improves: 68.7, 69, 65, 66, 60. The inverse relationship just mentioned is here more apparent.

Fig. 1 shows in graphic form the results of Table V. Distances on the axis of the ordinates represent speed in letters a minute; distances along the axis of the abscissae from 1 to 5 represent ascending steps in quality.

There seemed clearly to be a general tendency toward decrease of speed as quality improved. The curves show two other interesting facts: (1) in all grades speed averaged fairly constant at the

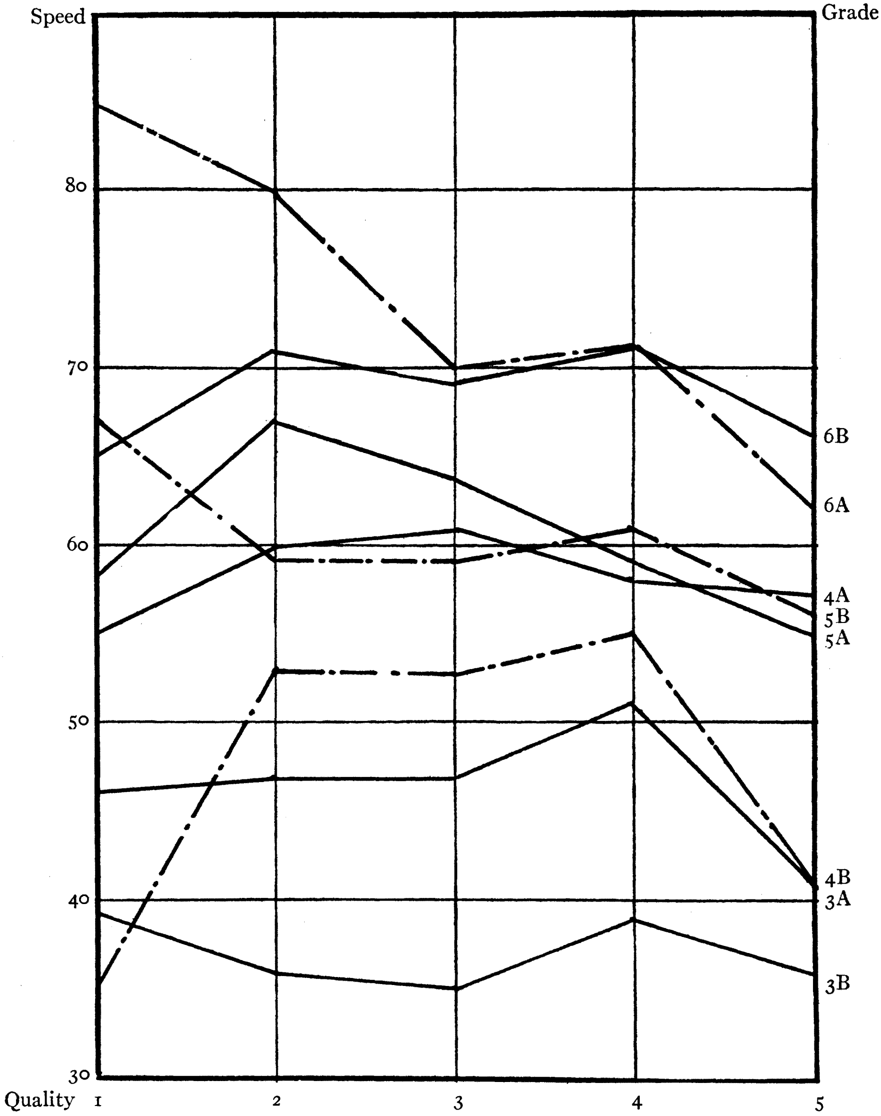

FIG. 1.—Average speed of writing in letters a minute for each section of each grade in the five quality groups of Table V. Quality 1 includes samples from 2.5 to 1.5 σ below the median; quality 2, the samples from 1.5 to 0.5 σ below the median, and so on.

three intermediate qualities; (2) in all grades speed decreased as quality improved from the fourth to the highest step.

In continuation of the study of the relation of quality and speed within the grade the data were tabulated in Table VI so as to show the average speed for each Thorndike quality in each grade within the range of the greater number of the samples. Though the quality range is only two steps on the Thorndike scale, the averages for Grades 5 and 6 show a general decrease of speed with improvement of quality. The averages for Grades 3 and 4 are irregular.

TABLE VI

AVERAGE SPEED IN EACH GRADE FOR VARIOUS POINTS ON THE THORNDIKE SCALE

QUALITY ON THE THORNDIKE SCALE	AVERAGE SPEED IN EACH GRADE									
	3B	3A	4B	4A	Average	5B	5A	6B	6A	Average
7.0	38	36	38	58	43	......	......	......	......	......
7.2	33	43	58	58	48	......	......	......	......	......
7.4	42	52	52	59	51	......	......	......	......	......
7.6	44	49	50	62	53	......	......	......	......	......
7.8	42	48	48	63	50	......	......	......	......	......
8.0	36	46	56	55	48	58	70	72	91	73
8.2	41	46	52	60	50	58	63	71	78	68
8.4	36	47	52	58	48	61	71	72	69	68
8.6	39	52	60	66	54	54	64	76	87	70
8.8	37	53	55	56	50	64	64	65	85	70
9.0	44	46	57	59	52	59	66	68	82	69
9.2	......	......	......	......	......	57	65	78	83	71
9.4	......	......	......	......	......	54	65	74	62	64
9.6	......	......	......	......	......	57	68	70	62	64
9.8	......	......	......	......	......	52	56	60	71	60
10.0	......	......	......	......	......	69	54	66	69	65

In an excellent diagram, using figures from the Cleveland survey, Judd[1] reports a consistent average decrease of speed accompanying improvement from quality 20 to quality 90, Ayres-scale values, *within* all grades from 5 to 8, inclusive. It is probable that the same regular average result would have been obtained in the present measurements if the number of cases had been larger. Judd calculated his averages from 10,528 samples, whereas there were only 1,267 in the present study.

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[1] C. H. Judd, *Measuring the Work of the Public Schools*, Survey Committee of the Cleveland Foundation, 1916, p. 70.

As for speed within the grades, therefore, we are brought to the conclusion that speed and quality are in general inversely related. In any given grade the highest quality especially was secured at a sacrifice of speed. If the teacher uses a range of five qualities in her scale of measurement, such as will be proposed later in this paper, she may expect approximately 7 per cent of the pupils to write at the lowest quality, 24 per cent to write at quality 2, 38 per cent at quality 3, 24 per cent at quality 4, and 7 per cent at quality 5. The pupils who write at quality 4 to the number mentioned may be expected to write about as rapidly as those who are rated at median quality. The 7 per cent who score at quality 5 may be expected to attain this quality at a loss in speed.

TABLE VII

SPEED AT SIGMA DISTANCES FROM MEDIAN, SAMPLES ARRANGED IN ORDER OF SPEED

SIGMA DISTANCE	SPEED IN LETTERS A MINUTE IN EACH GRADE							
	3B	3A	4B	4A	5B	5A	6B	6A
−2	14.5	18.0	26.5	34.0	45.0	35.0	43.0	47.5
−1	25.0	31.0	38.0	45.0	54.0	46.0	54.0	56.0
Median	36.5	45.0	52.0	57.0	59.0	63.0	72.0	75.5
+1	48.5	59.0	64.5	72.0	65.5	74.0	84.5	88.0
+2	70.0	76.0	84.0	88.5	72.5	92.0	96.0	97.0

TABLE VIII

VARIATION OF SPEED AND QUALITY FROM GRADE TO GRADE IN TERMS OF MEDIAN VALUES

ELEMENT	GRADE							
	3B	3A	4B	4A	5B	5A	6B	6A
Quality	8.0	8.2	8.6	8.6	9.2	9.4	9.6	9.8
Speed	37	45	52	57	59	63	72	76

Quality and speed between grades.—A study of the variation of quality and speed from grade to grade yielded a clearer result. Table VIII shows the median quality and median speed for each section of each grade from 3 to 6, inclusive. The median quality values were taken from Table II, the median speed values from Table VII.

GRADE

6A

5A

4A

had a li
had a litt
y had a li

.6

3A

Mary had a little la
mary had a little la
mary had a little lam

.2

3B

Mary had a little la
ry had a little lam

Ma
Ma
Ma

Mary had a litt
Mary had a litt
Mary hada litt

7.8

had a little lamb,
hada little lamb,
had a little lamb

7.4

little lamb
little lamb
a little lamb

Maff hade a little
Mdy had a litthe
Manyhad a litthe

.6

7.6

ttle la
ttle la
la

Mary had a little lamb
Mary had a little lamb
Mary had a little lamb

Mary
Ma
Ma

7.2

Mary had a little la
Mary had a little
Mary had a little l

Mary had
Mary had
Mary had

HIGHLAND PARK HAND

ad a little lamb
ad a little lamb
ada little lamb

Mary had a little lamb
Mary hada little lamb
Mary had a little lamb

7.8

8.8

mb.
amb.
amb

Mary had a litle lamb
Mary hada little lamb.
mary hada little lamb

Ma
Ma
Mary

8.4

little lam
little lamb
little lamb

Mary had a little lamb
Mary had a little lamb
Mary had a little lamb

8.6

1 Mary had a little lamb
Mary hada little lamb
Mary had a little lamb

✓ Mary ha
Mary ha
Mary ha

8.2

y had a little lamb
y had a little lamb
y had a little lamb

Mary had a li
Mary had a lit
Mary had a li

K HANDWRITING SCALE

le lamb.
le lamb.
le lamb.

Mary had a little lamb.
Mary had a little laml
Mary had a little lam

9.8

Mary had a little lamb
Mary had a little lamb
Mary had a little lamb

Mary had
Mary ha
Mary h

9.4

lamb
amb
amb

Mary had a little lamb.
Mary had a little lamb
Mary had a little lamb.

Ma
Ma
Ma

9.6

Mary had a little lamb.
Mary had a little lamb,
Mary had a little lamb.

Mary had a li
Mary had a lit
Mary had a lit

9.2

10.2

d a little lamb.
d a little lamb.
d a little lamb.

✓ Mary had a little la
Mary had a little la
Mary had a little la

amb.
lamb
lamb

Mary had a little lamb.
Mary had a little lamb.
Mary had a little lamb.

M
M
M

10.8

ary had a little lamb
ary had a little lamb.
nary had a littke lamb

✓ Mary had a lit
Mary had a lit
Mary had a li

10.4

11.4

Mary had a little lamb.
Mary had a little lamb.
Mary had a little lamb.

10.6

ad a little lamb.
d a little lamb.
ad a little lamb.

10.2

little lamb
little lamb
little lamb

SPEED

Mary had a little lamb.
Mary had a little lamb.
Mary had a little lamb.

76

11.8

d a little lamb
l a little lamb.
d a little lamb.

63

11.4

57

45

37

6A

5A

4A

had a li
had a litt
y had a li

.6

3A

Mary had a little la
mary had a little la
mary had a little la

.2

3B

Mary had a little la
ry had a little lam

Ma
Ma
Ma

QUALITY 6

Mary had a litt
Mary had a litt
Mary had a litt

7.8

had a little lamb,
had a little lamb,
had a little lamb

7.4

little lamt
little lamt
a little lamt

Mary had a little
Mary had a little
Mary had a little l

.6

7.6

ttle la
ttle la
lap

Mary had a little lamb
Mary had a little lamb
Mary had a little lamb

Mar
Ma
Ma

7.2

Mary had a little la
Mary had a little
Mary had a little l

Mary had
Mary had
Mary had

7

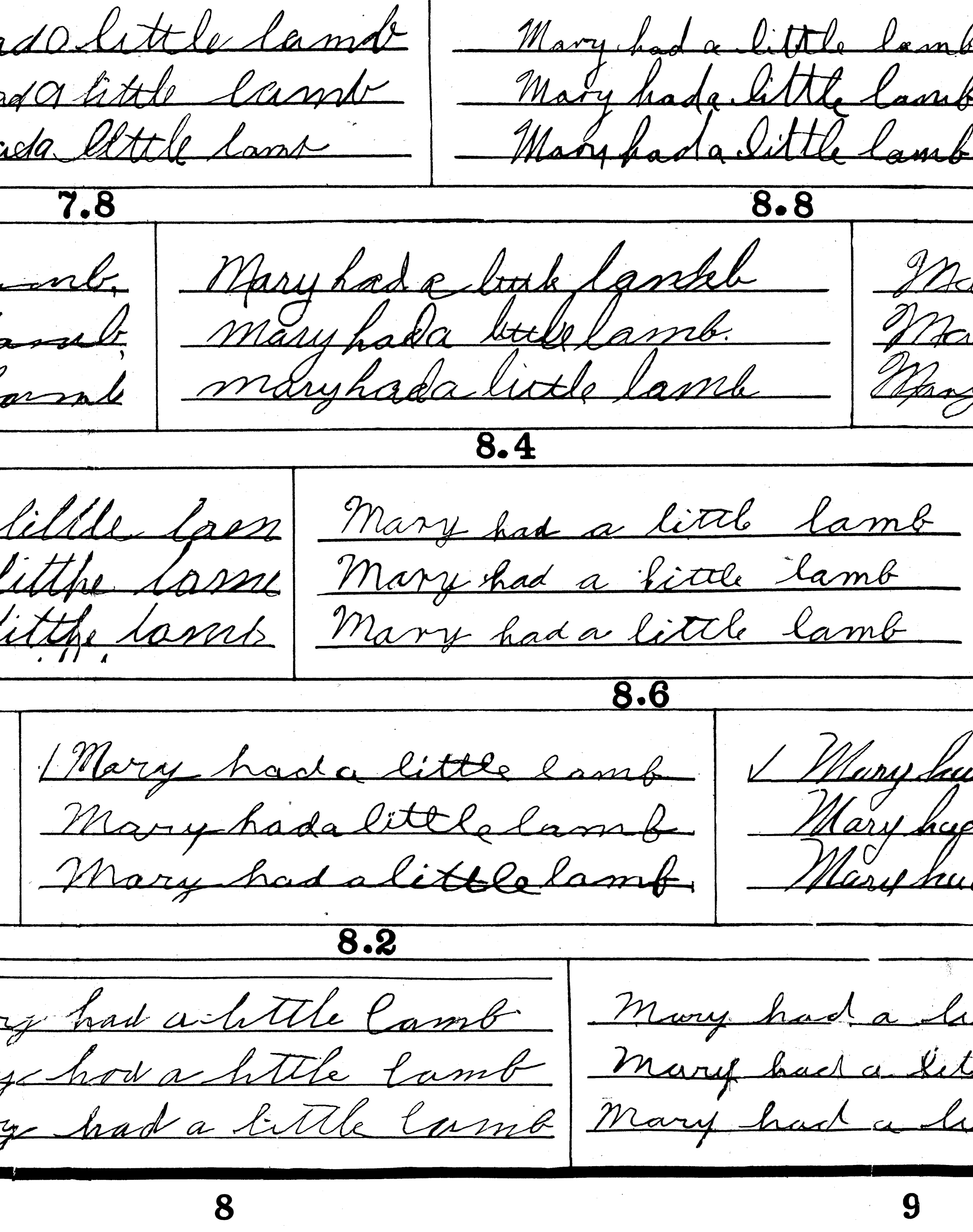
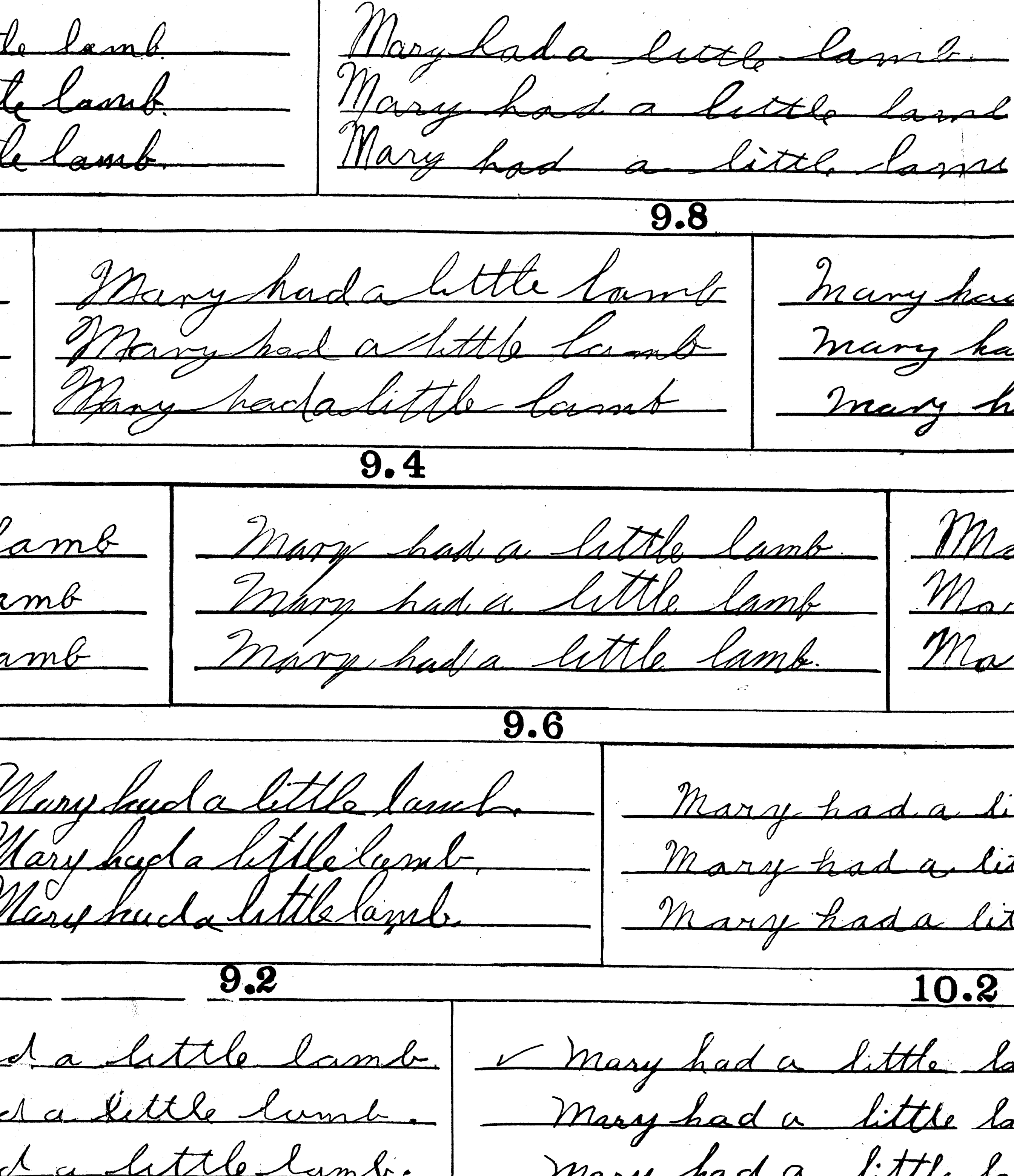


FIG. 2.—Survey of handwriting in Highland Park, Michigan, and sca
inclusive. Quality is represented horizontally in Thorndike scale units fr
to the right of its samples.



le lamb.
le lamb.
le lamb.

Mary had a little lamb.
Mary had a little lam
Mary had a little lam

9.8

Mary had a little lamb
Mary had a little lamb
Mary had a little lamb

Mary ha
Mary ha
Mary h

9.4

lamb
amb
amb

Mary had a little lamb.
Mary had a little lamb
Mary had a little lamb.

Ma
Ma
Ma

9.6

Mary had a little lamb.
Mary had a little lamb.
Mary had a little lamb.

Mary had a li
Mary had a lit
Mary had a lit

9.2

10.2

d a little lamb.
d a little lamb.
d a little lamb.

✓ Mary had a little la
Mary had a little la
Mary had a little la

9

10

ark, Michigan, and scale for the measurement of handwriting in Grades 3B–6A, horndike scale units from 6 to 12. The median speed for each grade appears

amb
lamb
lamb

Mary had a little lamb
Mary had a little lamb
Mary had a little lamb

M
M
M

10.8

ary had a little lamb
ary had a little lamb
nary had a littke lamb

10.4

✓ Mary had a lit
Mary had a lit
Mary had a li

11.4

Mary had a little lamb
Mary had a little lamb
Mary had a little lamb

10.6

ad a little lamb
d a little lamb
ad a little lamb

10.2

little lamb
little lamb
little lamb

Mary had a little lamb.
Mary had a little lamb.
Mary had a little lamb. 76

11.8

d a little lamb
a little lamb.
d a little lamb. 63

11.4

57

45

37

It will be observed that the median speed increased regularly from grade to grade; likewise the median quality. Not only was there a positive correlation between median speed and median quality; there was a similar, though less regular, correspondence between speed and quality from grade to grade in each of the five quality groups of Table V.

GRADE STANDARDS

We are therefore in a position to present a set of grade norms for both quality and speed. These are given in Table VIII. Such standards should be of direct service to supervisors and teachers. In Grade 5B, for example, it should be explained to the teacher that the supervisory staff will expect a median or average attainment in quality in that grade of at least 9.2, written at a median rate of not less than 59 letters a minute. With supervision of this character the teacher has certain clear-cut and justifiable ends of achievement. She is not asked to work along in vagueness and uncertainty, or to adopt aims that are arbitrarily devised. Carefully administered tests with impartial scoring should be instituted to inform her of the success of her instruction in realizing these rational ends.

For comparison with the quality and speed averages of the Highland Park schools, we present in Table IX corresponding quality averages and in Table X corresponding speed averages for Madison, Wisconsin, and Cleveland, Ohio, together with Starch's standards derived from tests made on 4,074 pupils in eight cities. All the averages from other cities presented here for purposes of comparison were obtained at the end of the school year and no divisions of grades were reported. In many of these cities, however, as in Cleveland, there were, no doubt, A and B sections of each grade. These were not considered separately. Starch obtained his samples at the end of the school year so that it would be possible "to establish definite standards of attainment in writing for each grade." But where a grade is divided as above mentioned it is evident that a standard of attainment should be based on a measurement of the advanced division of the grade when its unit of work is completed. In the following comparisons the mean quality and the mean speed for the two sections of each grade in Highland Park were used, since these figures rather than the figures for final grade achievement correspond to the scores presented for the other cities.

TABLE IX

QUALITY OF WRITING IN THORNDIKE UNITS FOR SEVERAL CITIES

City	Grade			
	3	4	5	6
Cleveland	....	....	9.6	9.9
Madison	7.8	8.6	9.2	9.8
Highland Park	8.1	8.6	9.3	9.7
Starch standards	8.2	8.7	9.3	9.8

TABLE X

SPEED OF WRITING IN LETTERS A MINUTE FOR SEVERAL CITIES

City	Grade			
	3	4	5	6
Cleveland	....	....	62	69
Madison	34	40	51	62
Highland Park	41	55	61	74
Starch standards	38	47	57	65

The quality and speed values given in Tables IX and X, except those of Cleveland, are comparable, grade for grade. In the Cleveland survey a different copy was used in the test and a different scale, Ayres, employed in the scoring. The Ayres values have been converted into their Thorndike equivalents.

The Highland Park quality scores, it will be noticed, average somewhat higher than the Madison scores and are below the Starch standards in every grade but the fifth, where the scores are identical. The Cleveland quality scores in the fifth and sixth grades are better than any of the other quality scores for these grades. The Highland Park schools are, plainly, writing below the norm in quality. How much below becomes clear on closer inspection of the data. A study of the quality figures for successive grades in all these cities shows that the average improvement for a grade in one year is one-half step on the Thorndike scale. On this basis Highland Park is approximately two months behind the Starch standards and four months behind the achievement of the Cleveland schools. See Table IX.

Let us now turn to the element of speed. A study of Table X shows that the Highland Park grades average 11 letters a minute more than the Madison grades, 6 letters a minute more than the Starch standards, and 2 letters a minute more than the Cleveland grades. It is plain that the grades of Highland Park are sacrificing quality for speed. The meaning of these differences in speed becomes clearer when they are compared with the average gain in speed from year to year for these grades in the cities measured. This average gain is found to be 10 letters a minute.

So far we have commented on the work in handwriting of these cities as wholes. An analysis of the findings, grade by grade, should be made by any superintendent interested. In this way the conspicuous sinners can be apprehended and corrected—grades which, like 4A and 6A in Highland Park, more noticeably sacrifice quality for speed.

THE SCALES

Finally, we submit in Fig. 2 the results of the handwriting survey in the form of five grade-section scales based on the quality values of Table III and the median speed values of Table VII. Each scale has five steps differing from each other serially by the same amount of merit. The steps cover a range of variation beyond which few students scored. Of the 1,267 pupils tested, 11 ranked above the highest quality, 11.8, of the scale for Grade 6A, and only 3 below the lowest quality of the scale for Grade 3B. By this it is not meant to argue that there would not be certain advantages in extending the scales in both directions beyond the present limits. If it is desired to score samples beyond these limits, the Thorndike scale can be used. But a superintendent may well ponder the advantage of retaining in the writing drill a pupil in these grades who has attained and maintains a quality of 12 at standard speed. Could we not at this point, without loss to the pupil or the business world, and with decided gain in incentive, apply the principle of the limitation of training and permit such a pupil, if he does not desire to specialize in writing, to devote himself instead to the typewriter or to subjects other than writing, in which he is less proficient? As Thorndike says, "The value now attached to the high qualities of writing is, of course, largely fictitious."

A sample of handwriting is measured by recording for it numerically the quality value of the sample on the combined scales which it is found upon comparison to resemble most. The scales represent present possibilities of attainment. They do not necessarily represent future limits of attainment. The proper expectation of improvement or the limit of attainment in average measures for any one of the grades studied is not yet known. But there is no better path to a knowledge of the truth about limits of attainment than the pathway of measurement which we have just been following. The grades of Highland Park will undoubtedly be able soon to score above the median measures herewith presented. The standards of attainment should then be correspondingly raised. But the present scale may continue to be of service even after the grade standards advance beyond the present median values.

It is hoped that this survey may not only be of service to Highland Park, but may offer some helpful suggestions to the supervisors in other cities for similar studies in the measurement and standardization of handwriting.